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[54] **SMEAR AND SCRATCH RESISTANT THERMALLY TRANSFERABLE PRINTING RIBBONS AND METHODS OF MAKING THE SAME**

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Related U.S. Application Data

[63] Continuation of Ser. No. 504,197, Jul. 19, 1995, abandoned.

[51] **Int. Cl.**[6] **B41M 5/26**

[52] **U.S. Cl.** **428/327**; 428/206; 428/331; 428/447; 428/484; 428/488.4; 428/500; 428/913; 428/914

[58] **Field of Search** 428/195, 484, 428/488.4, 447, 488.1, 500, 521, 206, 323, 327, 331, 913, 914

[56] **References Cited**

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[57] **ABSTRACT**

Smear and scratch resistant thermally transferable printing ribbons and methods of making the same consisting of elongated backing elements having thermally transferable printing media adhered to one side thereof. The thermally transferable printing media preferably consists of two layers, a sub coat layer and a print layer, and is capable of being transferred to paper, or some other print receiving media, by conventional thermal transfer printing equipment. The use of a silicon compound and/or ethylene bisstearamide and/or micronized polyethylene in the sub coat layer provides enhanced smear and scratch resistance in thermally transferred printed images while maintaining the advantage of low thermal energy print transfer.

16 Claims, 1 Drawing Sheet

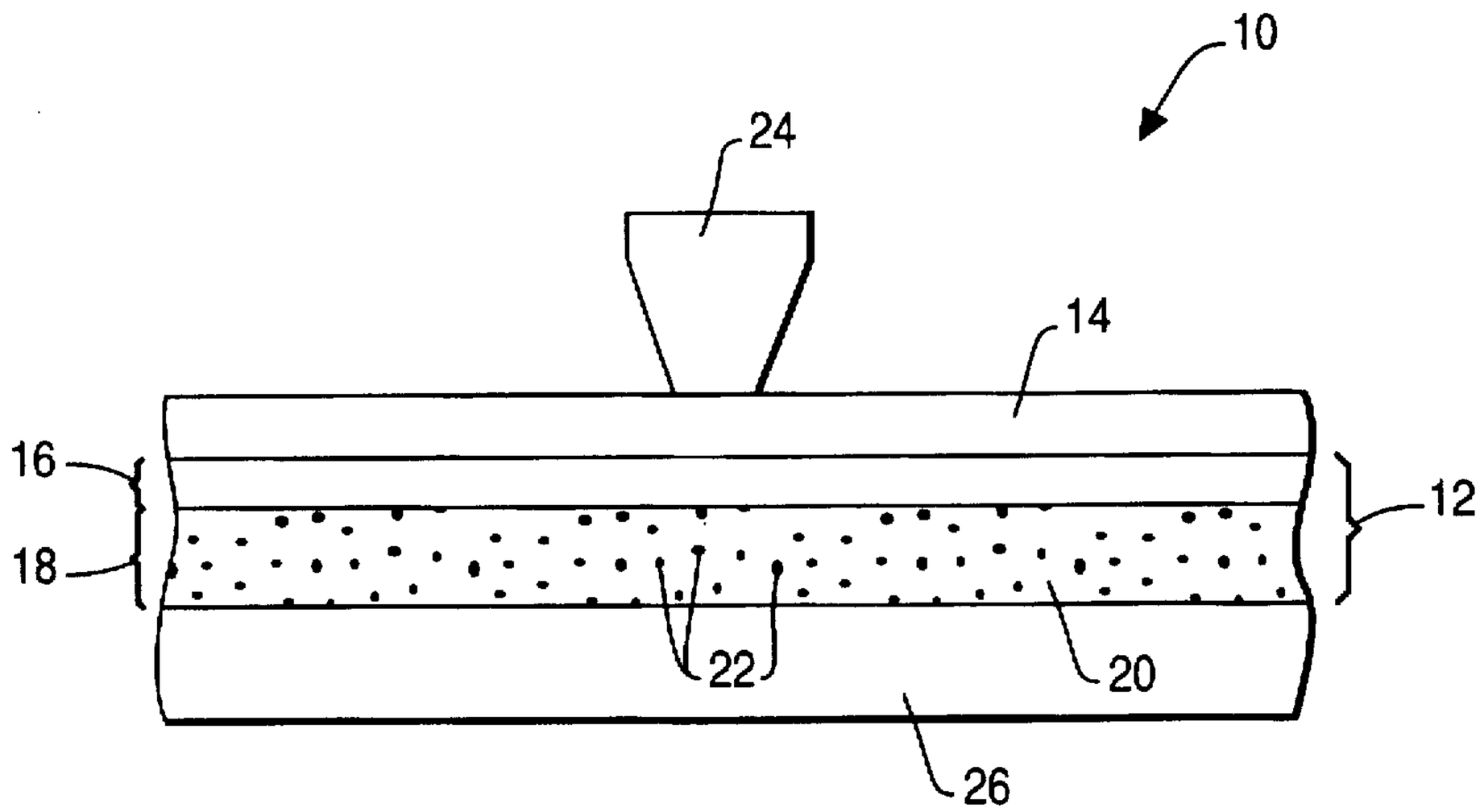


FIG. 1

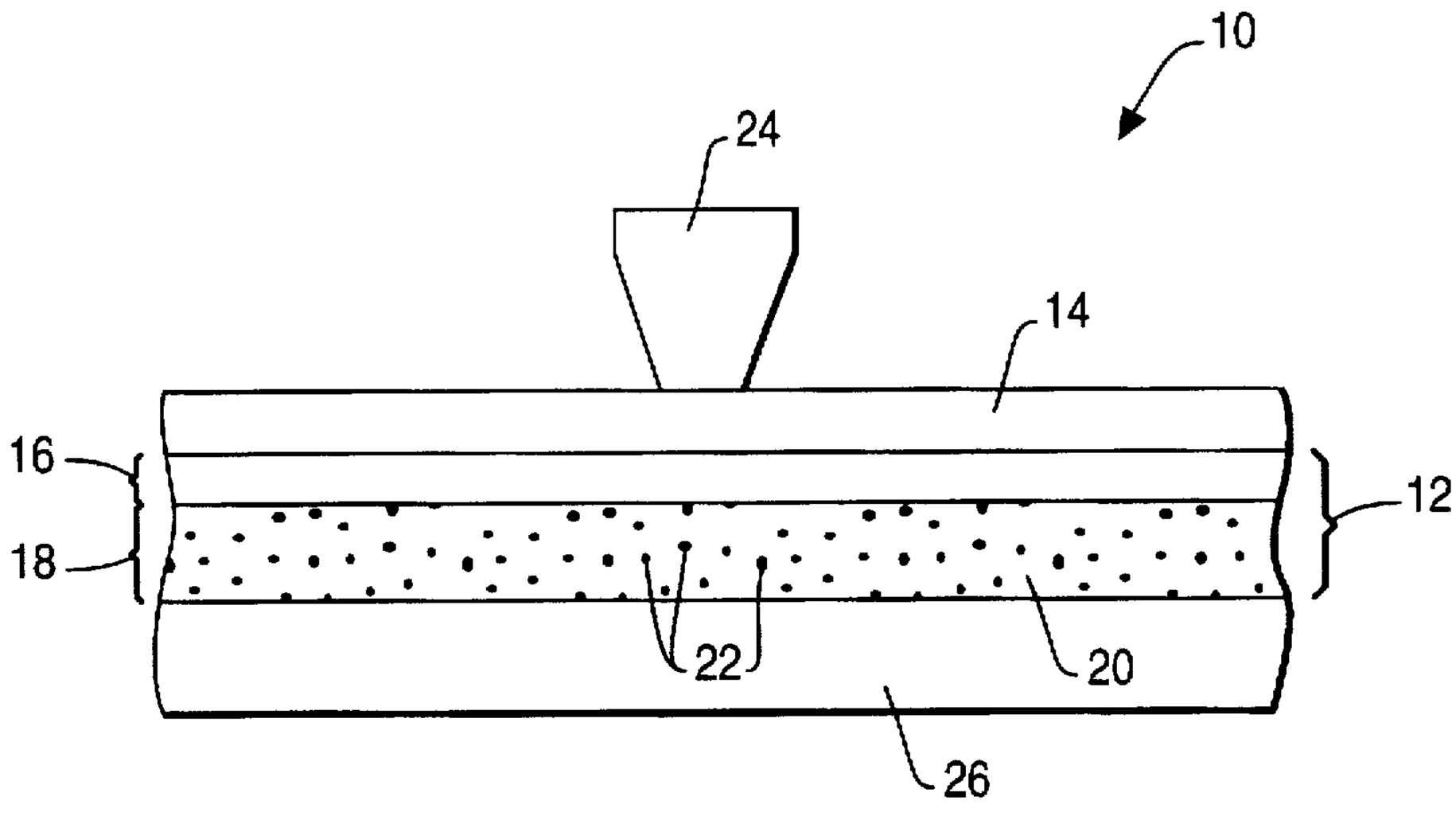
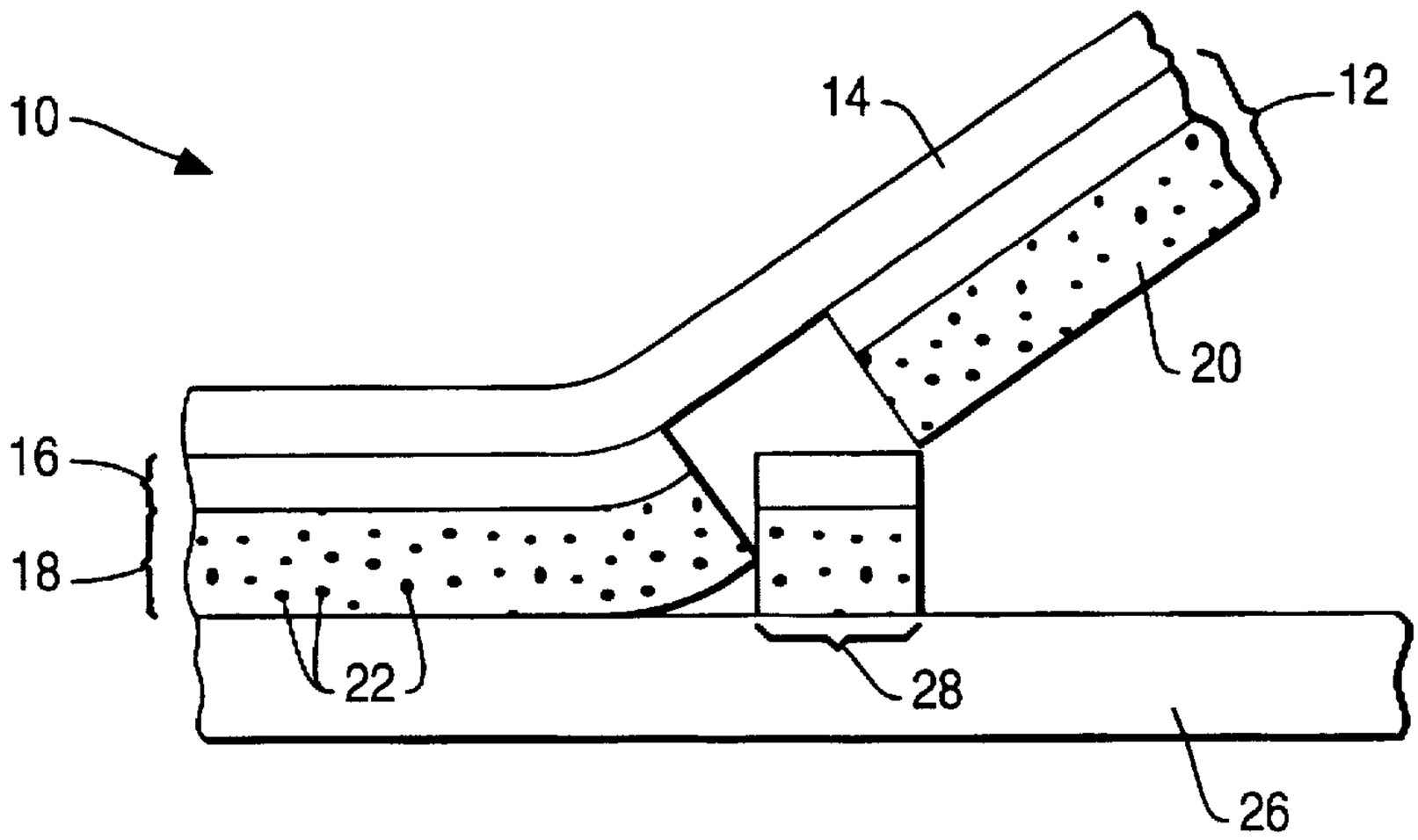


FIG. 2



SMEAR AND SCRATCH RESISTANT THERMALLY TRANSFERABLE PRINTING RIBBONS AND METHODS OF MAKING THE SAME

This is a continuation of application Ser. No. 08/504,197 filed on Jul. 19, 1995, now abandoned.

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention relates generally to new and novel improvements in thermally transferable printing ribbons and methods of making the same. More particularly, the present invention relates to thermally transferable printing ribbons and methods of making the same characterized by low thermal energy print transfer properties and enhanced thermally transferred printed image smear and scratch resistance.

One characteristic which is important in thermal transfer printing operations is the smear and scratch resistance of the thermally transferred printed image. One method of achieving higher smear and scratch resistance of a thermally transferred printed image is to increase the melting point of the thermally transferable printing ribbon printing media. However, another desirable characteristic of thermally transferable printing ribbons is a relatively low melt temperature to provide for low thermal energy printed image transfer. In general, low melting temperature thermally transferable printing ribbons currently available do not exhibit good smear and scratch resistance, particularly when printed upon coated receiver stocks.

Accordingly, an object of the present invention is the provision of smear and scratch resistant thermally transferable printing ribbons and methods of making the same having a thermally transferable printing media with a relatively low melting temperature.

Another object of the present invention is to provide smear and scratch resistant thermally transferable printing ribbons and methods of making the same with low thermal energy print transfer characteristics.

Still another object of the present invention is to provide smear and scratch resistant thermally transferable printing ribbons and methods of making the same which are capable of creating thermally transferred printed images having good smear and scratch resistance.

Yet another object of the present invention is to provide smear and scratch resistant thermally transferable printing ribbons and methods of making the same which are capable of creating thermally transferred printed images having good smear and scratch resistance when printed upon coated receiver stock materials.

These and other objects of the present invention are attained by the provision of smear and scratch resistant thermally transferable printing ribbons and methods of making the same consisting of elongated backing elements having thermally transferable printing media adhered to one side thereof. The thermally transferable printing media preferably consists of two layers, a sub coat layer and a print layer, and is capable of being transferred to paper, or some other print receiving media, by conventional thermal transfer printing equipment. The use of a silicon compound and/or ethylene bisstearamide and/or micronized polyethylene in the sub coat layer provides enhanced smear and scratch resistance in thermally transferred printed images while maintaining the advantage of low thermal energy printed image transfer.

Other objects, advantages and novel features of the present invention will become apparent in the following detailed description of the invention when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional side view of a preferred embodiment of a smear and scratch resistant thermally transferable printing ribbon showing a conventional thermal transfer print head transferring a thermally transferred printed image from the smear and scratch resistant thermally transferable printing ribbon to a print receiving medium in accordance with the present invention.

FIG. **2** is a cross-sectional side view of the thermally transferred printed image or character formed from the preferred embodiment of smear and scratch resistant thermally transferable printing ribbon shown in FIG. **1** fixed upon the print receiving medium.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring now to the drawings, in which like-referenced characters indicate corresponding elements throughout the several views, attention is drawn to FIGS. **1** and **2** which illustrate a first preferred embodiment of a smear and scratch resistant thermally transferable printing ribbon in accordance with the present invention, generally identified by reference numeral **10**. Smear and scratch resistant thermally transferable printing ribbon **10** consists of thermally transferable printing media **12** which is adhered to one side of elongated backing element **14**. Thermally transferable printing media **12** includes sub coat layer **16** adhered to one side of elongated backing element **14** and printing layer **18** adhered to sub coat layer **16** distal from elongated backing element **14**. Elongated backing element **14** is preferably a long narrow strip of a flexible polymeric material, most preferably a polyester film such as Mylar, available from E. I. Dupont de Nemours & Co., Incorporated in Wilmington, Del. Elongated backing element **14** should be compatible with thermally transferable printing media **12**, and preferably has sufficient tensile strength to resist tearing, while being sufficiently flexible to be wound around a spool or reel.

In the preferred embodiment shown, sub coat layer **16** of thermally transferable printing media **12** includes one or more of a silicon compound, ethylene bisstearamide and micronized polyethylene, in combination with micronized waxes and resins/binders. Printing layer **18** of thermally transferable printing media **12** includes a functional coating of waxes and/or resins and pigments and/or inks. In the preferred embodiment of smear and scratch resistant thermally transferrable printing ribbon **10**, printing layer **18** consists of binding substrate **20**, a formulation of waxes and/or resins, having an interspersed distribution of black or colored pigments **22**. Printing layer **18** is applied to the surface of sub coat layer **16** distal from elongated backing element **14** to form smear and scratch resistant thermally transferable printing ribbon **10**.

It will be recognized by those having ordinary skill in the relevant art that other pigments or inks could be substituted, or added, to black or colored pigments **22** in binding substrate **20**. For example, magnetic identification character recognition (MICR) pigments could be added to allow automated machine reading of the thermally transferred printed images and characters. In addition, fluorescent pigments or inks could be added, or substituted, for black or colored pigments **22** to permit "security" markings or ther-

mally transferred printed images which fluoresce, and become visible, when exposed to light having wavelengths in the ultraviolet spectrum. It should be recognized that various combinations of pigments and/or inks could be selected, as desired, to provide printed images and characters having the characteristics desired.

Binding substrate **20** retains the interspersed distribution of black or colored pigments **22** against elongated backing element **14** prior to the thermal transfer printing operation. In addition, binding substrate **20** retains the uniform interspersed distribution of black or colored pigments **22** once smear resistant thermally transferable printing media **12** is transferred onto paper or some other print receiving medium.

The table below shows a preferred formulation for one preferred embodiment of smear and scratch resistant thermally transferable printing ribbon **10** as shown in FIGS. **1** and **2**:

Ingredient	% Dry Weight	% Dry Range	Grams Dry	Grams Wet
Water				633.5
Isopropyl Alcohol				112.0
Latex	16.7	10–25%	33.4	87.9
Carnauba Wax	33.3	20–35%	66.6	66.6
Polyethylene Wax	25.0	20–35%	50.0	50.0
Dry Silicone	25.0	15–30%	50.0	50.0
Total	100.0		200.0	1000.0

In the above preferred formulation of smear and scratch resistant thermally transferable printing ribbon **10**, the isopropyl alcohol used is marketed by Ashland Chemical in Columbus, Ohio; the latex used is marketed as "EC-1052 latex by Environmental Inks in Morganton, N.C.; the carnauba wax used is marketed as "S-Nauba" by Shamrock Technologies Inc. in Newark, N.J.; the polyethylene wax used is marketed as "MPP-620-XF" by Micro Powders, Inc. in Tarrytown, N.Y.; the dry silicone used is marketed as GE-SR342 micro-fine silicone resin by GE Silicones in Waterford, N.Y.; and the backing element used is marketed as "4.5 micron Mylar Polyester Film" by E. I. Dupont de Nemours & Co., Incorporated in Wilmington, Del. Although the dry silicone used in the preferred formulation of smear and scratch resistant thermally transferable printing ribbon **10** described above is GE-SR342 micro-fine silicone resin, GE-SR348 micro-fine silicone resin and GE-SR343 micro-fine silicone resin dry silicones were also tested with acceptable, although less preferred, results.

To fabricate scratch and smear resistant thermally transferable printing ribbon **10**, a sub coat layer wax mixture is made for sub coat layer **16** by mixing water, isopropyl alcohol, latex, carnauba wax, polyethylene wax and dry silicone together at ambient room temperature. As an alternative, 100% isopropyl alcohol can be used as a carrier instead of the water and isopropyl alcohol combination in preparing the above sub coat layer wax mixture. In a separate operation, binding substrate **20** ingredients are mixed together and heated to a temperature of 190° F. for thirty minutes. Black or colored pigments **22** are then added to binding substrate **20** ingredients and the resultant printing layer **18** mixture is ground in an attritor for approximately ninety minutes. The wax mixture for sub coat layer **16** is coated onto elongated backing element **14** at a temperature of 140°–150° F. and a dry coat weight of 1.2±0.2 grams per square meter to form sub coat layer **16**. In a subsequent operation, printing layer **18** mixture is coated on the surface of sub coat layer **16** distal from elongated backing element **14** at a temperature of 140°–150° F. and a dry coat weight of 2.7±0.5 grams per square meter to form finished smear and scratch resistant thermally transferable printing ribbon **10**.

Referring again to FIGS. **1** and **2**, the use of smear and scratch resistant thermally transferable printing ribbon **10** in the thermal transfer printing operation will now be described. As seen in FIG. **1**, conventional thermal transfer print head, shown schematically as reference numeral **24**, is placed in contact with elongated backing element **14** with printing layer **18** of thermally transferable printing media **12** facing and in contact with print receiving medium **26**, for example, paper. Portions of thermal transfer print head **24** corresponding to the desired thermally transferred printed image or character **28** are then heated, typically by passing an electrical current through selective resistive elements. This heating is continued until the temperature of binding substrate **20** is above its melting point in those portions corresponding to the desired thermally transferred printed image or character **28**. These melted portions of thermally transferable printing media **12** are then transferred onto the adjacent surface of print receiving medium **26**, where binding substrate **20** again solidifies. During this transfer operation, binding substrate **20** carries along the interspersed distribution of black or colored pigments **22**, which are retained in solidified binding substrate **20**, onto print receiving medium **26**.

As seen in FIG. **2**, once binding substrate **20** has solidified on print receiving medium **26**, thermal transfer print head **24** is moved away and elongated backing element **14** is pulled away and separates from thermally transferable printing media **12** in those portions corresponding to the desired thermally transferred printed image or character **28**. At this time, thermally transferred printed image or character **28** is fixed on print receiving medium **26**.

When thermally transferable printing media **12** of smear and scratch resistant thermally transferable printing ribbon **10** is transferred onto print receiving medium **26**, sub coat layer **16** and printing layer **18** are transferred together onto print receiving medium **26**. Sub coat layer **16** thus becomes a protective top layer over printing layer **18** and which resists smearing or scratching of thermally transferred printed image or character **28**. Thermally transferred printed image or character **28** could include, for example, bar code and/or alphanumeric characters.

Although the present invention has been described above in detail, the same is by way of illustration and example only and is not to be taken as a limitation on the present invention. For example, although the use of thermally transferable printing media **12** having two layers has been described herein, the use of three, or more, layers could be readily accomplished utilizing the teachings of the present invention. Accordingly, the scope and content of the present invention are to be defined only by the terms of the appended claims.

What is claimed is:

1. A thermally transferable printing ribbon, comprising:

a backing element having a top surface;

a sub coat layer adhered to said top surface of said backing element, said sub coat layer including acrylic primer and dry silicone wherein said dry silicone is a micro-fine silicone resin having an average particle size of 0.5–3 microns and said sub coat layer having a top surface distal from said backing element; and

a printing layer adhered to said top surface of said sub coat layer, said printing layer including an interspersed distribution of black or colored pigments in a binder.

2. The thermally transferable printing ribbon in accordance with claim 1, wherein said sub coat layer includes carnauba wax.

3. The thermally transferable printing ribbon in accordance with claim 2, wherein said sub coat layer includes polyethylene wax.

4. The thermally transferable printing ribbon in accordance with claim 3, wherein said interspersed distribution of black or colored pigments includes carbon black pigments.

5. The thermally transferable printing ribbon in accordance with claim 4, wherein said interspersed distribution of black or colored pigments includes magnetic identification character recognition (MICR) pigments.

6. The thermally transferable printing ribbon in accordance with claim 4, wherein said interspersed distribution of black or colored pigments includes fluorescent pigments.

7. The thermally transferable printing ribbon in accordance with claim 4, wherein said backing element is an elongated polymeric material.

8. The thermally transferable printing ribbon in accordance with claim 1, wherein said sub coat layer includes polyethylene wax.

9. A thermally transferable printing ribbon, comprising:

a backing element having a top surface;

a sub coat layer adhered to said top surface of said backing element, said sub coat layer including 10 to 25% acrylic primer, 20 to 35% carnauba wax, 20 to 35% polyethylene wax and 15 to 30% dry silicone wherein said dry silicone is selected from a a micro-fine silicone resin having an average particle size of 0.5–3 microns and said sub coat layer having a top surface distal from said backing element; and

a printing layer adhered to said top surface of said sub coat layer, said printing layer including an interspersed distribution of black or colored pigments in a binder.

10. The thermally transferable printing ribbon in accordance with claim 9, wherein said interspersed distribution of black or colored pigments includes carbon black pigments.

11. The thermally transferable printing ribbon in accordance with claim 10, wherein said backing element is an elongated polymeric material.

12. The thermally transferable printing ribbon in accordance with claim 9, wherein said sub coat layer includes approximately 16.7% acrylic primer, approximately 33.3% carnauba wax, approximately 25.0% polyethylene wax and approximately 25.0% dry silicone.

13. The thermally transferable printing ribbon in accordance with claim 12, wherein said interspersed distribution of black or colored pigments includes carbon black pigments.

14. The thermally transferable printing ribbon in accordance with claim 13, wherein said backing element is an elongated polymeric material.

15. A thermally transferable printing ribbon, comprising:

a backing element having a top surface;

a sub coat layer adhered to said top surface of said backing element, said sub coat layer including acrylic primer and micro-fine powder silicone resin and said sub coat layer having a top surface distal from said backing element; and

a printing layer adhered to said top surface of said sub coat layer, said printing layer including an interspersed distribution of black or colored pigments in a binder.

16. A thermally transferable printing ribbon, comprising:

a backing element having a top surface;

a sub coat layer adhered to said top surface of said backing element, said sub coat layer including 10 to 25% acrylic primer, 20 to 35% carnauba wax, 20 to 35% polyethylene wax and 15 to 30% micro-fine powder silicone resin and said sub coat layer having a top surface distal from said backing element; and

a printing layer adhered to said top surface of said sub coat layer, said printing layer including an interspersed distribution of black or colored pigments in a binder.

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